and several special conditions, as specified in the public water supply operating permit issued to the City of Burbank by the California Department of Health Services (DHS). Since the treatment plant was designed with excess capacity, and can produce up to 9,000 gpm with no loss in treatment efficiency, EPA is confident that Option 2 will also meet drinking water ARARs. Options 3 and 4 would require modification to the treatment plant, but EPA is also confident that such modifications could be performed such that these standards would be met.

The treatment standards applicable to the Burbank OU treatment system were initially established in the ROD. The ROD required that the treatment system meet MCLs for all constituents (other than nitrates). Because water from the Burbank OU treatment system is conveyed offsite for use as a public water supply, and applicable drinking water standards may change, the consent decrees governing operation of the treatment plant recognize that EPA may identify requirements promulgated after the date of the ROD as ARARs in accordance with section 300.430(f)(1)(ii)(B)(1) of the NCP. That section requires attaining (or waiving) requirements promulgated after the date of the ROD where necessary to protect human health or the environment. This ESD does not change the treatment standards for operation of the treatment plant.

With respect to groundwater reinjection, ARARs include the California Regional Water Quality Control Board's (RWQCB) Non-degradation Policy, and Resource Conservation and Recovery Act (RCRA) Section 3020. The only option studied which involves reinjection is Option 4.

Any water reinjected on-site must meet all action-specific ARARs for reinjection. The reinjection must meet the "Statement of Policy With Respect to Maintaining High Quality of Waters in California," which requires that reinjected water not unreasonably degrade existing water quality. Nitrates are of concern with respect to reinjection; to avoid degradation, water from the Burbank OU treatment plant would have to be reinjected into an area of the aquifer containing as high or higher nitrate concentrations.

RCRA Section 3020 provides that the ban on the disposal of hazardous waste into a formation which contains an underground source of drinking water shall not apply to the injection of contaminated groundwater into the aquifer if: (i) such reinjection is part of a response action under CERCLA; (ii) such contaminated groundwater is treated to substantially reduce hazardous constituents prior to such reinjection; and (iii) such response action will, upon completion, be sufficient to protect human health and the environment.

Compliance with reinjection ARARs could be problematic for implementation of Option 4 due to high nitrate levels in the extracted and treated groundwater, and limited areas of the aquifer available for reinjection based on ARARs criteria.

Based on consideration of drinking water ARARs, Options 1, 2, and 3 are considered equivalent. Option 4 is considered less favorable than Options 1-3 due to potential difficulties in meeting reinjection ARARs.

2. Overall protection of human health and the environment

Options 1-4 are all protective of human health and the environment. In each case, direct threat of human contact with contaminated groundwater has been minimized. Extracted groundwater is being treated to meet drinking water standards before being served to the public. Therefore, the selection of any of the four options for interim remedial action would result in no change in protection to human health and the environment from that achieved under the interim remedial action established in the ROD and ESD1.

Options 1-4 all inhibit the spreading of the VOC plume to downgradient wellfields, and along with federal and state source water monitoring requirements minimize the likelihood that contaminated water from downgradient wells would be served to the public. As far as the degree of overall containment is concerned, based on studies performed by CH2M Hill and Lockheed, EPA believes that protection of the aquifer is adequate under Options 2, 3, and 4, and may be adequate under Option 1. This issue is discussed further in the section on long-term protectiveness below.

Options 1-4 all protect the environment from contact with contaminated groundwater. Under all four options, extracted groundwater is being treated and used as a public water supply and is not being discharged to the land surface. Option 4 differs from the other three options in that it requires reinjection of excess water. As long as reinjection ARARs are followed, Option 4 will not result in degradation of groundwater quality.

3. Short-term effectiveness in protecting human health and the environment

The analysis regarding short-term effectiveness of the Burbank OU interim remedy in protecting human health and the environment does not differ from the above analysis of overall protection of human health and the environment. Options 1-4 are all protective in the short-term. Phase 1 of the Burbank OU project has already been constructed, and treated groundwater is being provided to the residents of the City of Burbank without negative impact; therefore, Option 1 would not produce additional short-term impacts.

Options 2-4 would require additional construction activity. The only potential additional short-term impact to human health and the environment would be limited to minor, standard, construction concerns such as exposure to wind-blown dust, and noise impacts. The well drilling activities necessitated under these three options would be limited to one to two months in duration, would produce very little airborne dust, and noise would be limited to daytime hours. Option 2 would not produce any other short-term impacts. Options 3 and 4 would require an upgrade of the Burbank OU treatment plant, but this would consist of modifications to an existing plant and would not require significant excavation or earth moving activities, merely the addition or modification of existing physical components to the plant.

EPA believes any construction impacts would be minimal, and that Options 1-4 are all protective of human health and the environment in the short-term.

4. Long-term effectiveness and permanence in protecting human health and the environment

Options 1-4 would all maintain reliable protection of human health and the environment over time. Minor differences arise in the permanence of the various options. Since this is an interim remedial action, and the action itself is not considered permanent, permanence has not been considered a major factor in this evaluation.

However, in ranking the options with respect to permanence, EPA has evaluated to what degree they would contribute to aquifer restoration. Option 2 results in the greatest mass removal of PCE and TCE, suggesting that the combination of pumping rate and location of extraction wells is optimized under this alternative. The other options result in a similar degree of mass removal, with differences of only a few percent. This suggests that the 20 year period of groundwater extraction, which is not changed by this ESD, may be the controlling factor for mass removal. One unknown factor in this analysis is how much mass will continue to enter the groundwater system over the 20 year period of time. The final remedy will attempt to assess this effect and will attempt to address permanence in a more thorough analysis.

A comparison of mass removal for Options 1-4 over 20 years is presented below. These figures derive from an analysis performed by Lockheed Martin Corporation and reviewed by EPA, and EPA's consultant CH2M Hill. (See the Administrative Record: document entitled Evaluation of Extraction Scenarios for the BOU, dated

March 20, 1995, prepared by Hydro-Search, Inc.) The comparison of percent removal uses as a baseline the Burbank OU groundwater plume as defined by the 5 ppb contour line. Percent removal refers to the percentage of the mass within the 5 ppb contour which is removed by the Burbank OU extraction wells over the 20 year projected length of the interim remedy.

As noted, the amount of mass removed is greater at a 9,000 gpm extraction rate (Option 2) than at a 12,000 gpm extraction rate (Option 4). This is due to the need to meet reinjection ARARs for nitrates under Option 4. The locations where reinjection wells may be placed to meet ARARs are not favorable for mass removal, because under Option 4, the treated water must be reinjected in an area close to the extraction wells. The reinjected water actually displaces and dilutes contaminated water such that overall removal efficiency for TCE and PCE decreases.

Table 1 - Mass Removal Over Twenty Years

	% mass PCE removed	% mass TCE removed
Option 1[1]	89	73
Option 2[2]	92	78
Option 3[3]	91	78
Option 4[4]	88	75

The only other long-term protectiveness issue relates to air emissions from the Burbank OU treatment plant. The off-gas from the plant's aeration towers contains TCE and PCE molecules which have been stripped from the groundwater. Although this off-gas is treated with the use of air-phase granular activated carbon, a small quantity of TCE and PCE (less than 1% of the total present in the off-gas) is released to the atmosphere at an elevation of approximately sixty feet above the ground surface. The South Coast Air Quality Management District has reviewed the emission levels and found them well within ARARs for air emissions. EPA believes that emissions from Options 1-4 will not negatively impact human health and the environment, due to the low level of emissions, and due to their emission at a significant height above ground surface, away from people.

[1] 6,000 gpm pumping rate, no reinjection

[2] 9,000 gpm pumping rate, no reinjection

[3] 12,000 gpm pumping rate, no reinjection

[4] 12,000 gpm pumping rate, with reinjection

Nonetheless, Options 1-4 can be ranked in terms of overall emissions. The lower the groundwater extraction rate, the lower the rate of TCE and PCE removal, and the lower the rate of TCE and PCE emissions. Option 1 at a groundwater extraction rate of 6,000 gpm results in the least air emissions. Option 2 performs the next best in this respect. Options 3 and 4 result in slightly higher emissions.

5. Reduction of toxicity, mobility, and volume of contaminants

As stated above, EPA has evaluated to what degree the four options will contribute to mass removal. Mass removal of contaminants relates very closely to reduction in toxicity and volume of contaminants in the groundwater. Based on EPA's evaluation, all four options would result in similar degrees of reduction in toxicity and volume.

An assessment has also been made regarding the degree of hydraulic control Options 1-4 would exert over the groundwater contamination (Evaluation of Extraction Scenarios for the BOU, dated March 20, 1995, prepared by Hydro-Search). The degree of hydraulic control achieved relates very closely to reduction in mobility of the contaminants. The following comparison of hydraulic control is made based upon the groundwater plume as defined by the 5 ppb contour line (percent control refers to the percentage of the area within the 5 ppb contour which is contained, i.e. which does not move downgradient):

Table 2 - Hydraulic Control Over Twenty Years

	% control PCE	% control TCE
Option 1[5]	66	51
Option 2[6]	72	60
Option 3[7]	74	68
Option 4[8]	71	58

Based on this analysis, Option 3 would result in the greatest reduction in mobility, particularly with respect to control of the TCE plume. Options 2, 3, and 4 control to a similar degree the PCE plume. Option 1 clearly results in a lesser degree of

[5] 6,000 gpm pumping rate, no reinjection

[6] 9,000 gpm pumping rate, no reinjection

[7] 12,000 gpm pumping rate, no reinjection

[8] 12,000 gpm pumping rate, with reinjection

control. Option 3 turns out to be more efficient than Option 4, despite the fact that these options use the same pumping rate of 12,000 gpm, because based on current projections nitrate levels in the aquifer will not accommodate reinjection in hydraulically advantageous locations. A hydraulically advantageous location would be one where the reinjected water would assist in plume containment. ARARs requirements would restrict the placement of reinjection wells in areas where groundwater quality would not be degraded, meaning in areas where nitrates in groundwater are higher than nitrates in the water to be reinjected. If reinjection wells could be placed in the most hydraulically advantageous locations, Option 4 would be slightly superior to Option 3 in this regard.

When the interim remedial action is complete, EPA projects that contamination will remain in the groundwater under each of the four options. The final remedial action will determine how to address this remaining contamination.

Based on current data, Options 2 and 3 appear superior in terms of this criterion, but all options fulfill the goal of the ROD to partially control the movement and spread of groundwater contaminants in the Burbank OU area, while contributing to aquifer restoration.

6. Technical and administrative feasibility of implementation

The technical differences between the four options are as follows:

> Option 1 would require no additional construction. (Option 1 has already been implemented as Phase 1 of the interim remedy; therefore, it has been proven feasible.)
>
> Option 2 would require construction of 3,000 gpm of additional extraction wellfield capacity.
>
> Option 3 would require construction of 6,000 gpm of additional extraction wellfield capacity, plus a 3,000 gpm upgrade to treatment facility capacity.
>
> Option 4 would require construction of 6,000 gpm of additional extraction wellfield capacity, plus a 3,000 gpm upgrade to treatment facility capacity, plus construction of a 8,500 gpm reinjection wellfield.

In general, technical implementability increases in complexity as construction tasks are added to a project. Some construction tasks are more complex than others; for example, construction of a reinjection wellfield is more complicated than construction of an extraction wellfield due to more complex well specifications intended to reduce clogging of the well screens. Using this rationale, Option 4 is more complex than Option 3, which is more complex than Option 2, which is more complex than Option 1. As stated above, Option 1 has already been implemented technically (as well as administratively).

Ease of operation also factors into implementability. Application of proven technology generally reduces uncertainty of implementability, while application of a new technology increases uncertainty. Options 1, 2, and 3 all use common technology, while Option 4, by adding reinjection, uses a technology that has not been implemented widely in the geographic region of the Burbank OU.

Administratively, Options 1, 2, and 3, would be relatively simple because they would follow the framework developed during start-up of Phase 1 of the Burbank OU interim remedy. As part of Phase 1 start-up, EPA, the City of Burbank, Lockheed Martin Corporation, and DHS reached agreement on operational plans for the facility. Once again, Option 1, since it has been constructed and placed in operation, is not expected to present any administrative difficulties.

Construction of additional facilities, which would be necessary under Options 2, 3, and 4, would require amending the City of Burbank's public water supply operating permit, issued by DHS. Although this would be an additional administrative task, EPA is confident that additional permit conditions required by virtue of the addition of such facilities, would be achievable.

Option 3 would have the administrative complication of committing additional purveyors to accept water the City of Burbank could not accept. It is not likely that these additional purveyors would be willing to sign a consent decree, the chosen implementation document for the interim remedy. Lockheed Martin Corporation and the City of Burbank have both attempted, without success as of the date of this ESD2, to obtain the commitment of other local purveyors to accept Burbank OU water. Without this commitment, there is a good deal of uncertainty whether 12,000 gpm of groundwater could be purveyed on a routine basis, during periods when the City of Burbank could not accept the entire production of the Burbank OU facilities.

Option 4 would be more complicated to implement administratively due to the likely increased involvement of a regulatory agency, RWQCB, in the process. RWQCB has previously expressed reservations about reinjection based on water quality degradation concerns. However, EPA believes this additional administrative step would not present a barrier to implementation.

Based on technical and administrative considerations, Options 1 and 2 are considered superior. Options 3 and 4 have administrative complications, which would need to be resolved prior to implementation. Option 3 may present a barrier to implementation while Option 4 probably does not.

7. Capital and operation and maintenance costs

The following discussion compares the costs of Options 1-4 on a net present value basis. Costs include construction and 20 years of operation and maintenance. These costs are not based on the original estimates set forth in the ROD and in ESD1, but are based on more recent estimates prepared by a consultant to Lockheed Martin Corporation, the entity which has undertaken design and construction of the interim remedy under EPA oversight. (See the Administrative Record: document entitled Burbank Operable Unit Costs Comparison Summary, dated March 20, 1995, prepared by Parks, Palmer, Turner & Yemenidjian.) These estimates were independently reviewed by CH2M Hill, EPA's ARCS contractor. Therefore, the actual cost of the Phase 1 Burbank OU treatment facilities constructed by Lockheed Martin, the City of Burbank, and six other businesses, has been incorporated into these estimates. CH2M Hill's analysis is presented in a memorandum entitled Review of Burbank Operable Unit Costs Comparison Summary, dated November 11, 1996. EPA has concluded that the cost estimates prepared by Lockheed Martin used appropriate assumptions and are therefore appropriate for purposes of comparison of alternatives.

Option 1 is the least expensive of the four options. The capital cost for this option is estimated at $31 million in 1996 dollars. The present value of the 20 years of operation and maintenance is estimated at $88 million. Therefore, the total net present value of Option 1 is estimated at $119 million. Economic assumptions used by Lockheed Martin's consultant in this analysis are as follows: a discount rate of 8% was used; an inflation rate of 3% was used; calculations are in 1995 dollars.

Option 2 is more expensive than Option 1 but less expensive than Option 3. The capital cost for this option is estimated at $38 million in 1996 dollars. The present value of 20 years of operation and maintenance is estimated at $93 million. Therefore, the total net present value for Option 2 is estimated at $131 million.

Option 3 is more expensive than option 2 but less expensive than Option 4. The capital cost for this option is estimated at $49 million in 1996 dollars. The present value of 20 years of operation and maintenance is estimated at $97 million. Therefore, the total net present value for Option 3 is estimated at $146 million.

Option 4 is the most expensive of the four options. The capital cost for this option is estimated at $70 million in 1996 dollars. The present value of 20 years of operation and maintenance is estimated at $110 million. Therefore, the total net present value for Option 4 is estimated at $180 million.

For purposes of comparison, this information is set out in the following table:

Table 3 - Cost Comparison

Option	Capital	O&M	Total
1[9]	$31 million	$ 88 million	$119 million
2[10]	$38 million	$ 93 million	$131 million
3[11]	$49 million	$ 97 million	$146 million
4[12]	$70 million	$110 million	$180 million

8. State acceptance

EPA has coordinated with state agencies throughout this project, specifically RWQCB, the California Department of Toxic Substances Control (DTSC), and DHS. These agencies either accepted, or did not object to, the interim remedy originally designated by the ROD and ESD1. The Administrative Record details the communications between EPA and these State agencies throughout the interim remedy selection process.

Regarding the remedy discussed in the ROD and ESD1, the record reflects that the RWQCB supports the use of the treated water as drinking water, provided that all requirements for the serving of public drinking water are met. RWQCB agrees that reinjection may be implemented as long as compliance is achieved with respect to the "Statement of Policy With Respect to Maintaining High Quality Waters in California." (See the Administrative Record: letter dated June 8, 1990, from Hank Yacoub, RWQCB, to Alisa Greene, EPA; letter dated June 20, 1990, from Robert Ghirelli, RWQCB, to Alisa Greene, EPA.)

The record reflects that neither DTSC nor DHS stated a preference or rejection of any of the options presented in the ROD and ESD1. (See the Administrative Record: letter dated May 15, 1990, from

[9] 6,000 gpm pumping rate, no reinjection

[10] 9,000 gpm pumping rate, no reinjection

[11] 12,000 gpm pumping rate, no reinjection

[12] 12,000 gpm pumping rate, with reinjection

Hamid Saebfar, DTSC, to Alisa Greene, EPA, and letter dated June 11, 1990, from Gary Yamamoto, DHS, to Alisa Greene, EPA.)

In addition to reviewing the Administrative Record through the ROD and ESD1, EPA notified the state agencies regarding the proposed changes which would be made by ESD2. Neither RWQCB nor DTSC provided written comments on the options presented in ESD2. However, as stated above, EPA also has presented EPA's position on the ESD2 options to the state and other agencies at quarterly Management Committee meetings. EPA's understanding based on exchanges with representatives from these agencies is that neither RWQCB nor DTSC objects to EPA's approach.

DHS did provide written comments on the changes proposed by ESD2, but did not state a preference for any of the options presented herein. (See the Administrative Record: letter dated September 6, 1996, from Gary Yamamoto, DHS, to David Seter, EPA.) DHS raised the issue that "limiting the pumping rate to a maximum of 9,000 gpm and the elimination of the re-injection option may limit U.S. EPA's future success in containing the contaminant plume." In response to this comment, EPA believes the analysis presented in this ESD2, in terms of the nine NCP criteria, thoroughly considers the impact of the various options including the impact on plume containment.

Specifically, the nitrate levels currently projected in the aquifer do not accommodate reinjection in hydraulically advantageous locations. The City of Burbank has already agreed to maximize its use of treated groundwater, which will be an average of 9,000 gpm. An extraction rate of 9,000 gpm without reinjection thus accomplishes better hydraulic control than an extraction rate of 12,000 gpm with reinjection.

9. Community acceptance

The basic groundwater extraction and treatment concepts being evaluated in ESD2 do not differ greatly from the concepts evaluated in the ROD and in ESD1. The same degree of treatment will be applied to water made available as a public water supply. During the thirty day comment period provided for by EPA during the development of ESD1, there were no comments submitted by the public.

In addition, EPA will publish notice of availability of this ESD2 in a local newspaper of general circulation, and will consider any comments submitted by the public as required by 40 C.F.R. Section 300.825(c).

D. Decision on options

Based on the above analysis of Options 1-4, EPA has chosen Option 2, which consists of groundwater extraction at an average rate of 9,000 gpm, treatment by air stripping and granular activated carbon to remove VOCs, nitrate reduction by blending with a low nitrate water source, and use of the treated and blended water by the City of Burbank as a public water supply.

Option 2 was chosen because:

1) it performs equally as well as Options 3 and 4 and better than Option 1 at removing contaminant mass over a 20 year period of time;
2) it performs substantially as well as Option 3 and better than Options 1 and 4 at retarding migration of the groundwater contamination plume;
3) its total implementation cost is
   $15 million less than Option 3
   $49 million less than Option 4;
4) it avoids the potential administrative difficulties of Options 3 (identifying additional water purveyors) and 4 (resolving reinjection regulatory issues);
5) it complies with ARARs;
6) it is protective of human health and the environment.

This is an interim remedy. In the future, after the Burbank OU facilities have been operational for a substantial period of time, the optimal extraction rate may be better determined. This information will eventually factor into a decision on the final remedy. But for the purposes of ESD2, the data suggest that a groundwater extraction rate of 6,000 gpm may be too low to meet the groundwater containment objective. However, the data do not justify the added expense of raising pumping to a rate of 12,000 gpm. EPA has concluded that the Option 2 rate of 9,000 gpm is a reasonable, efficient, and cost-effective solution.

Although under ideal conditions pumping 12,000 gpm would provide greater containment than pumping 9,000 gpm, the reality of the ground water system as it exists in Burbank presents certain limitations. Under ideal conditions, nitrate levels would be low enough to meet ARARS reinjection requirements in areas determined to be hydraulically advantageous to reinjection. This is not the case, and is not likely to be the case throughout the time frame for implementation of the interim remedy. Because reinjection must take place in hydraulically disadvantageous locations, the effectiveness of Option 4 is lessened.

The Option 2 pumping rate is 9,000 gpm, which represents a 25% reduction in pumping versus Options 3 and 4. Yet, according to analyses performed by Lockheed Martin with which EPA concurs,